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The Lowdown on ADDITIVES

The Lowdown on Additives

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The guide that accompanies **The Lowdown on Additives** of the Science, Technology and Society series was written by Helen Brisbin.

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"All things are poisons, for there is nothing without poisonous qualities. It is only the dose that makes a thing a poison."
... Swiss physician and alchemist Philippus Aureolus Paracelsus (1493-1541)

The Science, Technology, and Society Series

STS is an international science education movement. It represents the first significant change in the science curriculum in 25 years. The STS concept strives to broaden the scope of science education by integrating into science curricula accurate presentations of the nature of science, the nature of technology and the interactions of science and technology with each other and society. This video series provides illustrative examples of the relationships between science, technology and society.

The STS connections describe products and processes; environmental and ethical issues relating to the interrelationships among science, technology and society; how scientific knowledge develops and the influence of society on scientific and technological research; and science and technology related careers. The contexts are meant to be relevant to students' lives and also prepare students for life in a rapidly changing society in which science and technology play an important role.

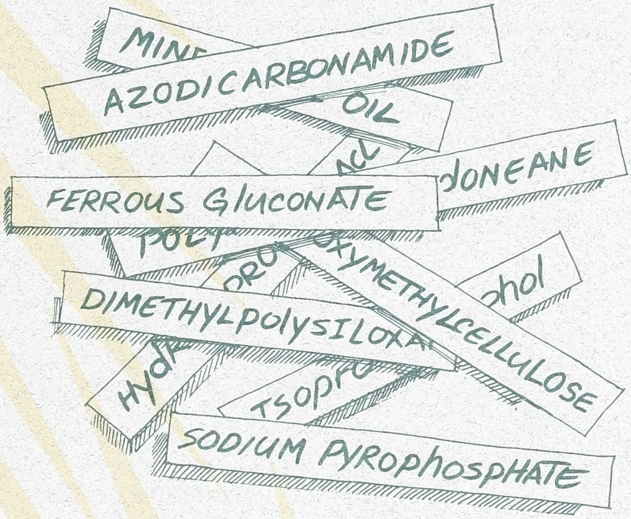
To The Teacher

One of the most important tasks of science teachers is to help students understand the scientific facts behind controversial issues. This program presents an objective look at food processing and food additives. Students will see why additives are an integral part of the food industry, and explore different types of additives and their uses.

Even "natural" foods are made up of a complex mixture of chemicals, which often includes toxins. Students will see that most of our food is perfectly safe to eat, as long as it is part of a balanced diet.

This video program is intended for use with integrated science, biology, chemistry, and physics courses at the senior high school level. Although it is geared to a high school audience, the program is also valuable to junior high students who are studying micro-organisms and food.

An interesting issue raised in this video is that of public opinion versus scientific knowledge. Why are there so many misconceptions about food additives? Is this a failure of the media, or are scientists responsible for providing information to the public?



Overview of *The Lowdown on Additives*

As the program opens, two young people in a grocery store are choosing from a vast display of foods, and discussing the additives on food labels. Related questions about the food additive issue are answered in the video. We learn that additives are not new, but have been used for thousands of years. We find out what food additives are, and why they are used in food processing. We examine the safety of food additives, and see how food testing is carried out. In the course of discovery we gain insights from food scientists and government food inspectors.

So what is the truth about food additives? As with many other issues, the more we learn, the less likely we are to see things in absolutes. Looking at food safety from a scientific perspective, food poisoning becomes a far greater health concern than food additives.

Information on Additives

Are Additives New?

Evidence suggests that food preparation and additives have gone hand in hand since the earliest civilizations. More than 3000 years ago, chefs were adding saffron, tumeric and paprika to enhance the colour of foods. Smoking and salting were ancient methods of preserving meat and fish. For the past several hundred years, people have been using saltpetre (potassium nitrate) as a curing agent.

Additives seem new because they are so prominent in today's food supply. One contributing factor has been the migration of people to cities. Over the past 50 years, the majority of the world population has become farther removed from its sources of food than ever before in history. Foods are shipped long distances across continents and oceans, and must be kept fresh.

Growth in populations has also prompted a more liberal use of food additives. We need enormous quantities of food to keep our cities well-stocked. Extending the shelf life of foods is crucial to maintaining a safe, adequate, and affordable food supply.

Advances in technology, the demand for convenience foods, and the more recent demand for low sugar and low fat foods have prompted a greater use of food additives. For example, low fat ice cream requires additives in order to create a pleasing texture while providing a healthier choice for discriminating consumers.

What Are Additives?

A food additive is a chemical that is added to food for a particular reason. The reason may be to preserve the food, or to enhance its texture or appearance. Food ingredients such as salt, sugar, starch, flavouring preparations, seasonings and spices are not considered to be additives.

Why Use Additives?

The main reason for using additives is to check the growth of micro-organisms so that foods will last longer. While bread can be made without additives to inhibit the growth of mould, it costs about five cents more per loaf. This is because bread without additives has a shorter shelf life, and must be transported quickly to markets.

Some additives are used to improve the appearance of the food product. Ascorbic acid, the chemical name for Vitamin C, keeps canned food looking fresh. Without this additive, many foods would turn dark in the tin.

Sometimes the nutrients in food will break down unless a chemical is added. Butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) in margarine are antioxidants, and protect the food's Vitamin A supply.

The following table lists some (not all) of the categories of additives and the reasons for adding these substances to foods. A few examples are listed from each category, but there are many more examples than the ones listed here.

Anticaking Agents

Prevent powders, such as salt and flour, from clumping. *Example:* calcium silicate, magnesium oxide, sodium aluminum silicate

Antifoaming Agents

Prevent foaming during the processing of foods such as jam. *Example:* monoglycerides, dimethylpolysiloxane

Antioxidants

Slow the process of oxidation, which makes fats turn rancid and frozen fruits turn brown. *Example:* citric acid, ascorbic acid, acetic acid, BHA (butylated lydroxy-anisole) and BHT (butylated hydroxytoluene), lecithin

Bleaching Agents

Produce a consistent colour in foods such as flour. *Example:* ascorbic acid, chlorine dioxide

Colouring Agents

Improve appearance of food. *Example:* caramel, carbon black, iron oxide, paprika, riboflavin (vitamin B)

pH-adjusting Agents

Increase or decrease acidity in food. *Example:* acetic acid, ammonium bicarbonate, calcium acetate, magnesium hydroxide

Preservatives

Prevent or delay food spoilage caused by microbial growth, yeasts or moulds. *Example:* sodium sulphite, sodium benzoate, potassium nitrite, potassium nitrate (saltpetre), sodium nitrite, woodsmoke, tartaric acid

Sequestering Agents

Combine with metallic elements in food, so that metals do not enter into reactions that could change the colour or taste of the food. *Example:* calcium disodium ethylene diaminetetraacetate (calcium disodium EDTA), calcium phytate, glycine

Sweeteners

Sweeten foods`with a minimum of added calories. *Example:* aspartame, mannitol, sorbitol, xylitol

Texture-modifying Agents

Produce a desirable consistency in food. This group includes emulsifying, stabilizing, thickening and gelling agents.

- Emulsifiers keep oil droplets suspended in another liquid (mayonnaise). Example: mono and diglycerides, lecithin

- Stabilizers keep suspended food particles from settling to the bottom (chocolate milk). Example: guar gum, locust bean gum, carrageenan

- Thickeners adjust consistency of processed products (ice cream). Example: sodium carboxymethyl cellulose

- Gels promote formation of gels (gelatin desserts, jams). Example: gelatin, pectin

Vitamin Supplements

Prevent diseases caused by vitamin deficiencies. *Example:* vitamin D added to milk

Other categories of additives include:

Carriers or Extraction Solvents
Firming Agents
Food Enzymes
Glazing and Polishing Agents
Humectants
Pressure-dispensing Agents
Release Agents
Starch-modifying Agents
Whipping Agents
Yeast Foods
Miscellaneous Agents used in carbonating, filtering, deodorizing, plasticizing (chewing gum), foaming and tableting processes

Artificial Flavours

Flavouring agents are listed on food labels as ingredients, but are not considered to be food additives. Amyl butyrate can be used to create the flavours of apricot, peach, plum, pineapple or pear. Cinnamaldehyde gives a cinnamon flavour, ethyl vanillin a vanilla flavour, and methyl salicylate a wintergreen flavour. Artificial flavours are commonly used in powdered drinks and candies.

Why Are Additives Distrusted?

Most people think natural foods are healthier than foods containing additives. The food industry is aware of this, and now markets products by advertising “No Preservatives” or “No Additives.” Researchers in the food industry are trying to “clean up the label”, not for any health reasons, but because of the public’s concern over additives.

People think of chemicals as artificial and distrust additives because they are made of chemicals. We sometimes forget that all foods are made up of chemicals. Whether those chemicals are natural or artificial does not matter to the body. Citric acid from lemon juice is processed by the body in the same manner as citric acid from a lab.

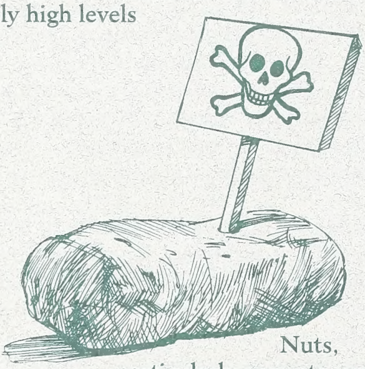
The media have contributed greatly to people’s mistrust of food additives. Sensational press about the dangers associated with different food additives leads people to complain that every food seems to be harmful.

Much of the public concern about diet should be directed at processed foods themselves rather than additives. Many processed foods contain unnecessarily high levels of sugar, salt, and fats that, in excess, are harmful to health. However, sugar, salt and fats are classified as *food,* not additives. Manufacturers are beginning to respond to consumer concerns by restricting sugar, salt and fat levels in more of their processed food products.

Even so-called “junk foods” like pop and french fries are not unhealthy unless they are eaten in excess. The argument can be made that many North Americans do include excessive amounts of sugar and fat in their diets. This, combined with a sedentary lifestyle, may be contributing to a high percentage of overweight people. A balanced diet contains plenty of fresh fruits and vegetables and a variety of other foods.

Is "Natural" Always Good?

Because we equate "natural" with "good", or "wholesome", we tend to overlook the fact that some natural foods produce toxic chemicals. The potato, a staple in many diets, contains over 150 different chemicals. Some of these are toxic, including solanine, alkaloids, oxalic acid, arsenic, tannins and nitrate. Since the concentrations of harmful chemicals are small, potatoes are good for you–with one exception. If the potato has a greenish-tinged skin, or is sprouting, the peel is harmful and should be discarded. It contains unacceptably high levels of solanine.



Nuts, particularly peanuts, are commonly infected with a mould called Aspergillus flavus, which produces the carcinogen, Aflatoxin B. Roasting destroys up to half the aflatoxin, and mechanical or manual sorting reduces the levels even further. Products which show more than 15 parts per billion of aflatoxin cannot be sold in Canada. When it comes to peanut butter, processing actually reduces a naturally occurring toxin.

Natural Toxins

Earth's plant life contains many substances that have been developed as medicines. It also contains poisons. Alkaloids, found in potatoes and some other vegetables, are used in the production of morphine, quinine and strychnine. Strychnine has proven for centuries to be an effective natural rat poison. Heroin and opium are derived from the poppy plant, marijuana from the hemp plant, and cocaine from the leaves of the coca plant. High levels of cyanide are found in the shoots, twigs and seeds of apples, cherries, peaches, plums and apricots. Mushrooms come in all varieties–from edible to hallucinogenic, to highly toxic. The stimulant caffeine is found in natural products such as coffee, tea and cocoa. Ten grams of caffeine can kill an adult.

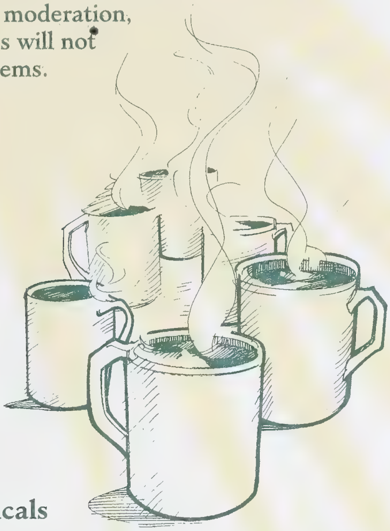
More poisons enter our bodies each day as *natural chemicals* in the *natural foods* we eat than from all other sources combined.

Many substances naturally present in food would not be approved for use today if they had been manufactured in a laboratory and submitted to Canada's Health Protection Branch. Vitamin A is a good example. Eating ten times the recommended intake of Vitamin A could be toxic. Additives, on the other hand, must have a safety factor of one hundredfold. They must contain 100 times less quantity of additive than the "no-effect" level for humans. (See p. 5 for explanation of the "no effect level".)

Some Toxins or Carcinogens Found Naturally in Food

Oxalic acid	*Found in rhubarb and spinach. Can lead to kidney damage.*
Tannic acid	*Found in coffee, black tea and cocoa. Can cause cancer of the mouth and throat.*
Dimethylnitrosamine	*Found in cooked bacon. Can cause cancer.*
Glycyrrhizic acid	*Found in licorice. Can lead to hypertension and cardiovascular damage.*
Hydrazines	*Found in raw mushrooms. Can cause cancer.*
Myristicin	*Found in black pepper, carrots, celery, dill, mace, nutmeg and parsley. Can cause hallucinations and liver damage.*

In every case, it's the dose that makes the poison. Eating 100 grams of licorice per day for several consecutive days could cause health problems. Drinking 70 cups of coffee in one day would be a lethal dose of caffeine. Even water is lethal if taken in excessive amounts. If we eat a variety of foods in moderation, most natural toxins will not cause health problems.



Nature's Chemicals

While we think of food additives as being synthetic chemicals, in many cases they are derived from natural products. Carrageenan comes from seaweed extract. It improves the texture of ice cream, and actually adds healthful fibre to the product. Lecithin is a product of soybeans. It is used in whole milk powder to help the milk dissolve in water. Locust bean gum comes from seeds, and carboxymethyl cellulose is a product of wood pulp.

Some chemical and common names of foods and food additives are as follows:

Chemical Name	**Common Name**
citric acid	lemon juice
sodium chloride	salt
acetic acid	vinegar
sucrose	table sugar
glucose	corn syrup
fructose	fruit sugar
ascorbic acid	vitamin C
sodium bicarbonate	baking soda
papain	papaya extract (meat tenderizer)
cinnamaldehyde	cinnamon
monosodium glutamate	MSG

Are Additives Safe?

Although we don't always make healthy dietary choices, the food we eat is almost always safe. Canada has one of the world's safest food supplies. All ingredients used in processed foods must be listed on the label, in order of quantity, from greatest to smallest. Additives are not permitted in some products such as fresh eggs, milk* and meat.

Canada's Health Protection Branch has a list of approved food additives. It is a relatively short list, and only one or two new substances are added in a year. New additives must pass stringent safety tests before being included on the approved list.

The amount of a food additive is usually measured in parts per million (ppm). Scientists determine the allowable amount by first establishing the "*no-effect level*". This is the amount of additive which can be given *without* causing any reaction in testanimals.

Once the "no effect level" is established, then the "Acceptable Daily Intake" (A.D.I.) of the additive is worked out. Usually this involves dividing the "no-effect level" by a safety factor of 100.

For example, if the "no-effect level" of a substance is found to be 1000 mg. per kilogram of body weight, the Acceptable Daily Intake is calculated at 10 mg. per kilogram of body weight *per day over a lifetime.*

While most additives are completely harmless, nitrites *have* been linked with cancer. They can react in the stomach to produce the carcinogen **nitrosamines.** Nitrates and nitrites are commonly added to cured meats. They enhance the flavour and colour. But most importantly, they prevent the growth of Clostridium botulinum spores. These bacteria produce an extremely dangerous and potentially fatal type of food poisoning called botulism. The risk of developing cancer from eating nitrites is minimal compared to the risk of botulism.

Eliminating all cured meats from one's diet would decrease the total intake of nitrites by only about 22 per cent. Many vegetables, including spinach and carrots, contain nitrates. When nitrates combine with the bacteria in saliva, they produce nitrites. Therefore, a good portion of our nitrite consumption comes from "natural" foods. Vitamin

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** With the exception of Vitamin D, which is added to milk to prevent deficiencies. Vitamin D helps the body absorb calcium. We get vitamin D from sunlight, but in northern climates, children may have little exposure to sunlight during winter months. Vitamin D added to milk prevents rickets, and other skeletal malformations.*

C eaten with nitrites has been found to decrease the production of nitrosamines.

A small percentage of the population is allergic to certain additives such as sulphites. These individuals must take special precautions, as do people with food allergies.

***No Effect Level* ÷ 100 =** Acceptable Daily Intake
Per Day
(***For a Lifetime***)

The Real Danger

The greatest danger associated with eating food in Canada comes not from additives, but from microbial food poisoning. Symptoms of nausea, vomiting, diarrhea and stomach cramps are often mistaken for viral infections. For this reason, it is hard to pinpoint the number of cases that occur annually in Canada, but it is well over 100,000 and may be as high as half a million.

In the vast majority of cases, microbial food poisoning is caused by improper handling or storage of food. It happens in homes, restaurants and institutions. The main microbial culprits are Salmonella, Staphylococcus aureus, Campylobacter, and Verotoxigenic E. coli (VTEC). Bacteria can multiply rapidly in non-acid or low-acid foods such as eggs, meat or milk. The Campylobacter bacteria is found in unpasteurized milk.

Botulism is the least common but most dangerous form of food poisoning. The botulinum micro-organism is the most deadly poison known on earth. Five grams of the toxin (one teaspoon) would be enough to kill over one billion people. Tetanus and diphtheria toxins rank as the world's second and third most deadly poisons. One form of dioxin, which does not occur in nature but must be chemically produced, comes next, as the fourth most deadly toxin.

The majority of cases of botulism are a result of improper methods used in home canning of low acid vegetables and meat. Clostridium botulinum spores can be destroyed by heating the contents of a jar or can to 260 degrees Fahrenheit or 127 degrees Celsius. These temperatures can only be reached with a pressure canner.

Botulinum is the"World's most deadly poison.
100% natural."

Potential Hazards In Food

Scientists		**Consumers**
Highest		*Lowest*
	Microbiological	
	Animal Pharmaceuticals	
	Environmental Pollution	
	Pesticides	
	Food Additives	
Lowest		*Highest*

Popular perception of what constitutes a danger in food is the opposite of scientific opinion

Monitoring Food Safety

Health Canada's Food Inspectors monitor food processing in Canada. They check a product's food ingredients and additives, and also ensure that sanitary conditions are maintained. Food inspectors are alert for the danger of cross contamination of ingredients. Because some people have severe food allergies, it is very important that ingredients from one type of food do not accidently spill into another type of food.

Food inspectors take samples of food for laboratory testing. Food is analyzed for its nutritional value, and for additives and contaminants. It is also checked for extraneous material or filth, such as fragments of metal or glass, rodent hair, and insect parts.

Of Canadian foods tested, 99.76% are found to be in compliance with government guidelines.

Inspectors also check shipments of processed foods from other countries to make sure that the product is acceptable for sale within Canada.

Various methods are used to test foods. A simple chromatography test will identify the colourings found in food samples. This test has been used for over twenty years because it is fast and economical. Most testing for other ingredients is much more complex, involving computers, high technology instruments such as lasers, and a series of chemical processes to complete the analysis.

Sulphites

Canada's Food Inspectors test extensively for the presence of sulphites in foods. Sulphites can produce what is known as an "exquisite allergy" in affected individuals—a very small amount of this additive can quickly lead to an allergic reaction so severe that it may cause death.

Sulphites are preserving agents, and are permitted only in certain foods. They are always listed on the label of packaged foods, but may also be present in restaurant foods, and in bulk foods which are sold in supermarkets. Sulphites are now banned from restaurant salad bars, and are not permitted on fresh fruit, with the exception of grapes which are very prone to mould.

People who are allergic to sulphites must be extremely careful about reading food labels, and checking with the chef before they eat in restaurants. They should also avoid alcoholic beverages unless they are sure of the ingredients, because the beverages may contain sulphites.

Names of Sulphiting Agents

potassium bisulphite
potassium metabisulphite
sodium bisulphite
sodium metabisulphite
sodium sulphite
sodium dithionite
sulphurous acid

Sulphiting agents are commonly found in jams, relishes, tomato paste, catsup and puree, candies, fruit juices, frozen mushrooms, beverages. They must be listed on labels, with the exception of alcoholic beverages. (Steps are now being taken to legislate listing ingredients on alcoholic beverages.)

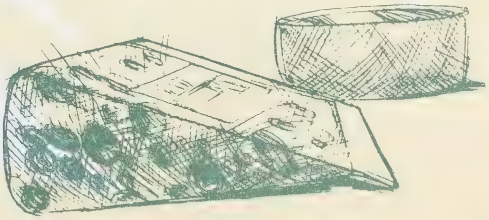
Unintentional Additives

Some additives end up in food by accident. These include mycotoxins such as Aflatoxin B, which result from naturally occurring moulds and fungi. Other unintentional additives may include agricultural pesticides and fungicides, residues of drugs commonly given to livestock, contaminants from food packaging, and fragments of extraneous matter, or filth, which may get into the food during shipping, storing, or processing.

Although these sound ominous, none is considered to be a significant health concern at this time. Consumers can reduce chemical residues by washing fruits and vegetables, peeling root vegetables, and discarding the outer leaves of leafy vegetables. Synthetic pesticide residues we may be ingesting from fresh fruits and vegetables compose only a tiny proportion (about one ten thousandth) of the natural pesticides and poisons contained in foods.

A simple test using amino acids is used to detect the presence of drug residues in meat, and the meat is rejected if traces of drugs are found.

Additives can "migrate" into food from the packaging. Inks, dyes and preservatives from cardboard and paper may become part of the food. When glass is re-used, the residues from detergents may find their way into the food product. Small amounts of cadmium and lead will migrate into canned foods. Plastics contain complex mixes of chemicals, many of which can migrate into food. Unreacted monomers, plasticizers, stabilizers and antioxidants all become possible additives. A plastic wrapped cheese slice almost certainly contains plastic which has leached into the fat in the cheese.



As for filth, it's there. Raisins and grated cheese are two good examples. They may include things like metal particles, mammal hairs, mites, insect fragments, wood fragments and filaments from feathers. Fortunately, the fragments are too small to notice. In low doses, the body doesn't notice either.

Food Irradiation

One of the chief reasons for using additives is to preserve food: to delay spoilage due to the growth of moulds or bacteria and to delay sprouting in tuber crops like potatoes. Irradiation is a technology which has been in place for many years, but has never gained widespread public acceptance. Irradiation of food is one of the most effective ways to preserve foods, and leaves no harmful residues.

Although there are solid arguments in favour of food irradiation, there are concerns about its safety. Certainly the public has an aversion to combining "radiation" with anything we ingest. Aside from emotional considerations, there are some concerns that irradiation may be used to disguise poor food storage and processing procedures.

Food Science

The study of food additives is just one small part of an industry which includes a wide range of opportunities. Food scientists may work in any number of enterprises, from agriculture to food processing and medical research. They may be dieticians, nutritionists, chemists, biologists, lab technicians, or other specialists. Food is a necessity, and also a source of great pleasure and fascination. Almost everyone dabbles in food science in their own kitchens. Food scientists make this a life's work.

Suggested Activities

1 Looking Delicious

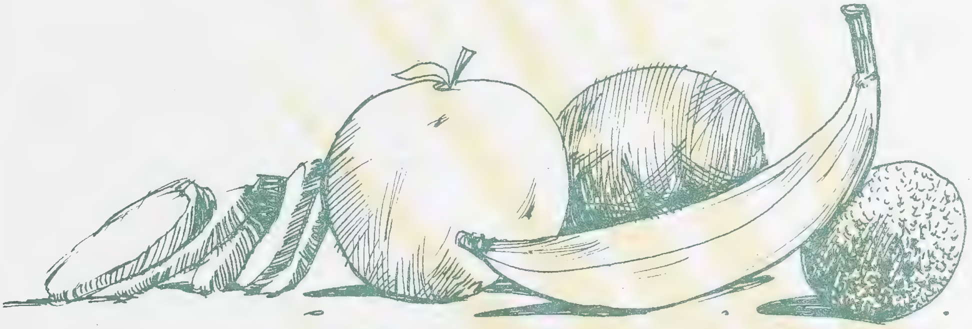
Take four slices from an apple, a banana and a potato, and make four groups which include the three foods. Rub a vitamin C tablet over the surface of the foods in one group. Put some vinegar on the slices in the second group. Put lemon juice on the slices in the third group, and leave the fourth group of slices exposed to the air. Leave the foods for a few hours, and see what happens.

Apples, bananas and potatoes all have enzymes that react with oxygen in the air, and turn the food brown in colour. The untreated slices will turn brown fairly quickly. All the other slices will turn brown much more slowly, or not at all. Why?

Answer

Vitamin C contains ascorbic acid. Vinegar contains acetic acid, and lemon juice contains citric acid. In every case, the acid lowers the pH of the enzyme so that it becomes ineffective. The food therefore becomes oxidized much more slowly, or not at all.

Acid is a food additive which is often seen on processed foods. Lemon juice sprinkled over a fruit salad is a simple example of a common food additive. It is done to enhance the appearance of the food.



2 Label Check

Have students check the label of a processed food, and list and state the purpose of the additives. Note: Many food processing companies now include a 1-800 number on their packaging, and students may have access to additional information through these numbers.

3 Plant Enzymes That Digest Proteins

Meat tenderizers are often used prior to cooking to reduce toughness. This “tough” quality in meat results from the protein **collagen** found within the connective tissue in muscle. The active ingredient of a meat tenderizer is a **proteolytic or protein-degrading enzyme called papain**. The papain enzyme will **hydrolyse** the fibrous collagen as well as muscle proteins into constituent amino acids.

Papain is extracted from unripe papaya, a tropical melon. Other plants contain similar proteolytic enzymes; these include **ficin** from figs and **bromelain** from pineapples.

Problem

To examine the effects of two proteolytic enzymes, papain and bromelain, on proteins. Since it is difficult to directly observe the influence of these enzymes on a meat product, gelatin will be used as the protein substrate. Gelatin is a gel formed from protein molecules. A little green food colouring added to gelatin mixture will improve the visual contrast.

Materials

Fresh pineapple
Canned pineapple rings
Ice bath
Prepared gelatin (i.e., Knox) - 5 dishes per group
Meat tenderizer containing the enzyme papain

Note: One dish of gelatin for each group should be prepared, with meat tenderizer (1/2 tsp.) added just after the boiling water. This dish should be cleary labelled.

Procedure

A. Papain

1. Sprinkle meat tenderizer liberally on the surface of one dish of gelatin. Leave at room temperature for 5 minutes. Note any changes in the surface of the gelatin. Gently poke the surface with a glass rod. Continue to assess the texture at five minute intervals for the duration of the lab period.

2. Using a dish of gelatin that has been thoroughly chilled in a container of ice, repeat the procedure in step #1. Leave the gelatin-enzyme combination on ice for the duration of the lab period.

3. Assess the texture of a third dish of gelatin in which the meat tenderizer was added to the hot gelatin during the preparation phase.

4. Record all observations.
   Sample #1 (room temp.)
   Sample #2 (ice)
   Sample #3 (hot)

B. Bromelain

1. Place a slice of fresh pineapple on the surface of one dish of gelatin and slice of canned pineapple on the surface of a second. Dry each pineapple slice carefully with paper towel before placement.

2. After five minutes, assess the surface of the gelatin. Continue to observe the gelatin at 5 minute intervals for the rest of the lab period.

   Note: The liquid observed is not a result of juice from the pineapple.

3. Record your observations.
   Fresh Pineapple ____________________

   Canned Pineapple ____________________

Questions

1. What happens to the structure of the gelatin as protein hydrolysis occurs?

2. Was there any effect of temperature on the action of the papain?

3. What did you observe with the papain added to the hot gelatin? Can you explain your results in terms of the composition and structure of the enzyme?

4. Why do fresh pineapple and canned pineapple react differently?

Answers

1. *Protein network formed in the gelatin is broken down, resulting in loss of the gelatin texture. Water entrapped in the protein network is also released.*

2. *Room temperature is faster. Cold temperature decreases molecular motion and frequency of collision. Enzyme activity is also decreased.*

3. *No effect since the enzyme is denatured by high temperatures.*

4. *Enzyme in canned pineapple is inactivated because of high temperatures reached in processing.*

Source: *Food Chemistry,* M.A.H. Ismond, E.D. Murray Food Science Department, University of Manitoba

4

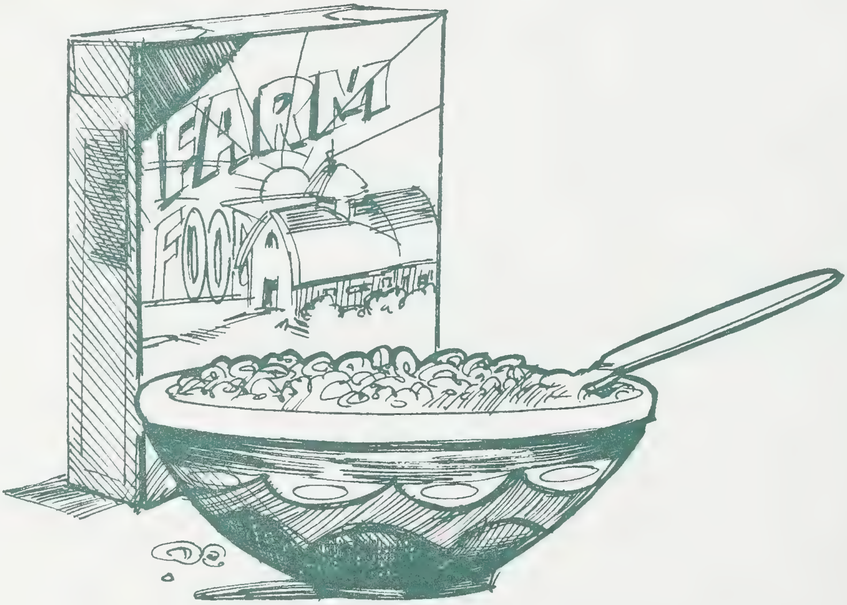
Health Cereal vs. Junk Cereal

Compare a box of "healthy" breakfast cereal, such as granola, to a sugary children's cereal. Ingredients and nutritional values will be listed on the package.

Is there a significant difference in nutritional value between the two cereals?

How do the ingredients compare? Compare the sugar content in the cereals. Remember that sweeteners are not always grouped together. They may be listed as sugar, brown sugar, sucrose, glucose (aka dextrose), fructose, corn syrup, and honey. Raisins are also rich in sugar.

Depending on the make of the "health" cereal, students may find there is not much difference between the two.



5 Making Curd

Problem:

To examine the curd from milk prepared by two different chemical methods.

Materials

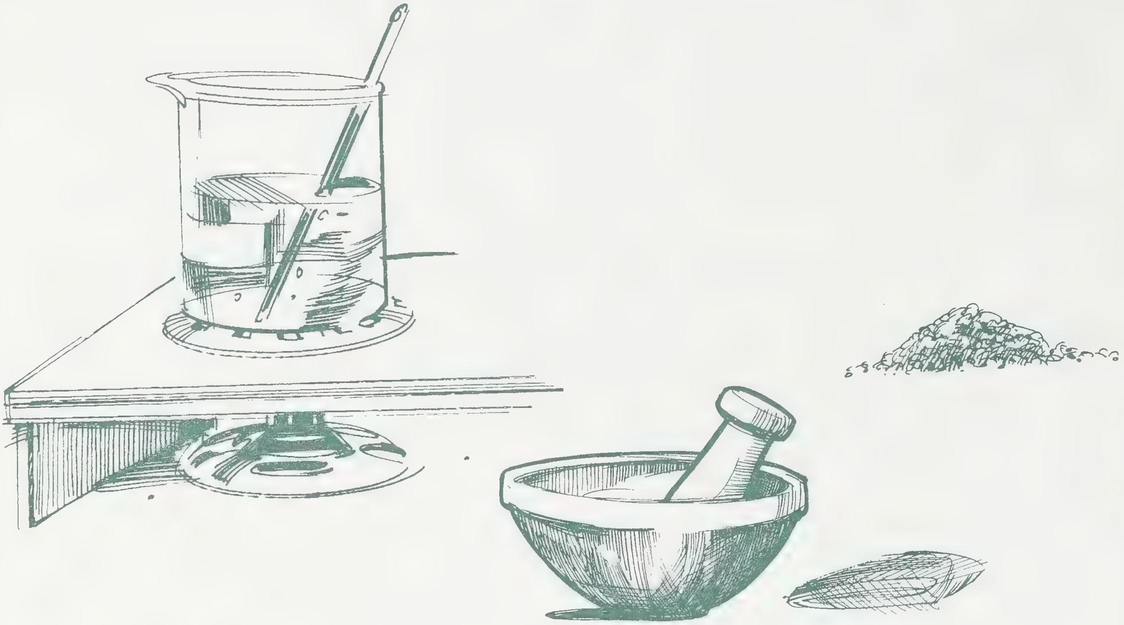
400 mL fresh milk
Junket tablets (for rennin)
Vinegar (5% Acetic acid)
Beakers
Thermometers
Hot plate or bunsen burner
Cheese cloth
Glass rods

Procedure

1. Place 200 mL of milk in each of two beakers.
2. Heat both milk samples to 30°-32° C. Check the temperature with a thermometer. DO NOT OVERHEAT!
3. Crush one junket tablet with a mortar and pestle. While stirring with a glass rod, add half the tablet to one milk sample. Label the beaker.
4. Add 30 mL of vinegar to the other milk sample and stir gently. Label the sample.
5. Gradually increase temperature of both beakers to 38 degrees C., but no higher.
6. Remove the beakers from the heat and allow to sit for at least 15 minutes. Do not disturb the contents.
7. Filter the contents of each beaker through 4 thicknesses of cheese cloth. Your cheese is on the cloth.
8. Press all liquid from the cheeses and allow to dry.
9. Carefully examine the two cheeses for differences in texture.

Questions

1. How do the two cheeses differ in terms of their textural properties? Can you relate the consistency of the acid-based product to any cheese on the market? (*Cheese made with rennin is more elastic. Cheese made with acid is less elastic and more fragile, like cottage cheese.)*



Source: *Food Chemistry*, M.A.H. Ismond, E.D. Murray Food Science Department, University of Manitoba

6

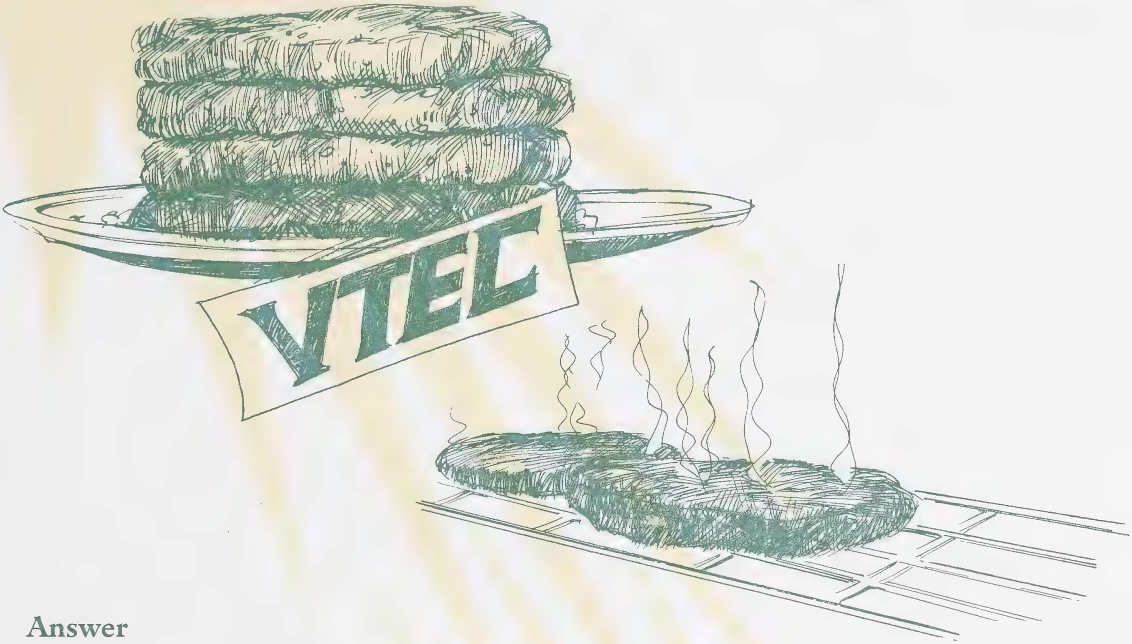
Case Study in Food Poisoning

When Jamie's family has a barbecue, they tend to follow the same routine. Jamie's mother mixes up hamburger patties, which she leaves on a plate on the kitchen counter until the barbecue is ready. She does not always wash her hands after handling the raw meat.

Jamie's father cooks the hamburger patties until they are medium-well done. He then puts them back on the same plate used to carry the raw patties.

One week after the last barbecue, Jamie developed diarrhea. After a couple of days, he began to experience stomach cramps and bloody diarrhea. He was taken to the hospital, where tests showed he had a bacteria called VTEC (verotoxigenic E. coli) in his system. Luckily, it did not spread to his kidneys or blood, and Jamie recovered.

VTEC is sometimes known as "hamburger disease" or "barbecue syndrome". Over the past ten years, food poisoning caused by VTEC has increased dramatically. In some cases it leads to kidney failure and even death. How could Jamie's family have avoided this incident?



Answer

VTEC is a bacteria found in unpasteurized milk, poultry, and any ground meat. Hamburger meat is the most common source. Besides avoiding unpasteurized milk, there are safety steps you can take to minimize the risk of infection by VTEC.

- *never leave raw ground meat or poultry at room temperature, as this allows rapid growth of bacteria*
- *wash hands thoroughly after handling raw meat or poultry*
- *use hot, soapy water to wash utensils and plates which have come into contact with raw meat or poultry*
- *wash cutting boards in hot soapy water, followed by a rinse with a bleach solution to destroy bacteria*
- *cook hamburgers until they are well done all the way through*
- *be sure poultry is completely cooked*
- *use a clean plate to carry the cooked meat or poultry*

If you're eating at a restaurant or somebody's home, do not eat pinkish-looking ground meat or poultry. Send it back to be cooked completely, or leave it on your plate.

Note: The fact that unsafe food handling and preparation has never made you sick in the past does not mean you won't be affected in the future.

7 Botulism

Have students research the organism Clostridium botulinum. How is it usually spread, and can you tell if a food is contaminated?

Answer

Clostridium botulinum, the organism that causes botulism, likes to grow where there is no oxygen (jars and cans). It produces a toxin which attacks the nerves and can lead to paralysis and death. The bacteria usually produce a gas and a foul smelling odour, but there are some strains which cannot be detected so easily.

If you find a bulging can, it's wise not to open it. Take it back to the store, or dispose of it in a safe place. Never even taste canned food that is mouldy or has a bad odour. Do not buy dented cans, and do not eat food from cans that appear to be rusted, or damaged in any way. Canned food should be eaten within one year of purchase.*

The greatest risk of botulism in Canada comes from home-canned foods, particularly meats and vegetables which are low in acid. These foods should only be processed in a pressure canner which can reach temperatures high enough to kill the spores of clostridium botulinum.

A safer (and easier) way to preserve food is to store it in a chest type freezer.

**The seams of the can may be damaged enough to let in bacteria, which could contaminate the food inside.*

8 Food Moulds

Have students research food moulds. Is it safe to eat food that has gone mouldy?

Answer

Not a good idea. Some moulds produce mycotoxins which can be highly toxic even in small amounts, and may be carcinogenic. In a liquid or semi-liquid, these toxins may have spread throughout the container. It is safe to cut a small patch of mould off hard cheese, if you cut a good 2.5 cm. beyond the mould.

All moulds are not harmful. The mould in Roquefort cheese is edible, and a mould is used in the production of penicillin. With the exception of Roquefort cheese, consumers can't be sure whether or not a mould is safe to eat.

9 Diet

If you are unsure about the safety of any food, a good rule of thumb is:
"When in doubt, throw it out".

10 Irradiation

Why is it healthier to eat a wide variety of foods, rather than to eat large quantities of a few foods? If we say that anything eaten in excess is hazardous, can we say that anything is safe if eaten in small amounts?

11 Approved Additives

Have students do research into the pros and cons of food irradiation. What is it that prevents this technology from being implemented?

12 Unnecessary Additives

Why is it that additives may be approved in Europe and banned here, or approved here and banned in Europe? Why is saccharin permitted as a sweetener in the United States but not in Canada?

Recommended Resources

Food Additives: Questions and Answers. Health Protection Branch, Health and Welfare Canada, 1990

Food Additive Pocket Dictionary. Health Protection Branch, Health and Welfare Canada, 1990

Various pamphlets on foods and food safety available from the Health Protection Branch.

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